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PTO/SB/21 (09-04)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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TRANSMITTAL FORM (to be used for all correspondence after initial filing)	Application Number	09/785,194 (US Patent No. 6,717,242) B2
	Filing Date	February 20, 2001 (Issued: April 6, 2004)
	First Named Inventor	Shinji TAKEDA et al
	Art Unit	2827
	Examiner Name	David Graybill
Total Number of Pages in This Submission	Attorney Docket Number	TM&K0006

ENCLOSURES (Check all that apply)		
<input type="checkbox"/> Fee Transmittal Form	<input type="checkbox"/> Drawing(s)	<input type="checkbox"/> After Allowance Communication to TC
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Certificate
NOV 02 2004
of Correction

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT			
Firm Name	GRIFFIN & SZIPL, P.C.		
Signature			
Printed name	Joerg-Uwe Szipl		
Date	October 28, 2004	Reg. No.	31,799

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TRANSMITTAL FORM (to be used for all correspondence after initial filing)	Application Number	09/785,194 (US Patent No. 6,717,242)
	Filing Date	February 20, 2001 (Issued: April 6, 2004)
	First Named Inventor	Shinji TAKEDA et al
	Art Unit	2827
	Examiner Name	David Graybill
Total Number of Pages in This Submission	Attorney Docket Number	TM&K0006

ENCLOSURES (Check all that apply)		
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Remarks		

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT		
Firm Name	GRIFFIN & SZIPL, P.C.	
Signature		
Printed name	Joerg-Uwe Szipl	
Date	October 28, 2004	Reg. No. 31,799

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Signature		
Typed or printed name		Date

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NOV 04 2004



THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: Shinji TAKEDA et al.)
U. S. Patent No. 6,717,242 *B2*) Atty. Docket: TM&K0006
Issued: Apr. 6, 2004) Group Art Unit: 2827
Applicant: Hitachi Chemical Co., Ltd.)
Serial No. 09/785,194)
Filed: Feb. 20, 2001) Examiner: GRAYBILL, D.
For: SEMICONDUCTOR DEVICE AND) Date: October 28, 2004
PROCESS FOR FABRICATION)
THEREOF)

REQUEST FOR EXPEDITED CERTIFICATE OF CORRECTION

ATTN: Certificates of Correction Branch

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In printing the above-identified patent, the U. S. Patent and Trademark Office printed entirely incorrect claims, as evidenced by the attached copies of Amendments (A), (B), and (C) filed during prosecution of the patent, as well as the copy of the Notice of Allowability indicating allowance of claims 25-65.. The correct claims are set forth on the attached Certificate of Correction forms PTO/SB/44. To facilitate entry of the correction, Applicants have renumbered allowed claims 25-65 to begin with claim 1.

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Patent No. 6,717,242
Atty. Docket No. TM&K0006

Please issue the Certificates of Correction and send the same to the undersigned attorneys for Applicant. In view of the severe nature of this error, and the fact that the error is that of the PTO, Applicant respectfully requests expedited issuance of the Certificates of Correction under MPEP § 1480.1 and 37 C.F.R. § 1.322.

Respectfully submitted,

GRIFFIN & SZIPL, PC

Joerg-Uwe Szipl
Reg. No. 31,799

GRIFFIN & SZIPL, PC
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UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

Page 1 of 3

PATENT NO. : 6,717,242 *B2*
DATED : April 6, 2004
INVENTOR(S) : Takeda, Shinji; Masuko, Takashi; Yusa, Masami; Kikuchi, Tooru; Miyadera, Yasuo; Maekawa, Iwao;
Yamasaki, Mitsuo; Kageyama, Akira; and Kaneda, Aizou

It is certified that error appears in the above-identified patent and that said Letters Patent
is hereby corrected as shown below:

Please delete all of the claims, numbered 1-6, from column 16, line 56 to column 18, line 16, and replace them with the
following claims 1-41:

1. A process for fabricating a semiconductor device, comprising the step of:
bonding a semiconductor device to a support with an organic die-bonding film at conditions of temperature of 100-250°C
and pressure of 0.1-30 gf/mm² to produce a bonded chip wherein the organic die-bonding film has a peel strength of 0.5 kgf/(5
mm x 5mm chip) or higher.
2. A process according to claim 1, further comprising the step of:
encapsulating the bonded chip to produce the semiconductor device.
3. A process according to claim 1, wherein said step of bonding comprises bonding with an organic die-bonding film having
a modulus of elasticity of 10 Mpa or less at a temperature of 250°C.
4. A process according to claim 3, wherein said step of bonding comprises bonding with an organic die-bonding film further
having a water absorption of 1.5% by volume or less.
5. A process according to claim 4, wherein said step of bonding comprises bonding with an organic die-bonding film further
having a residual volatile component in an amount of not more than 3.0% by weight.
6. A process according to claim 5, wherein said step of bonding comprises bonding with an organic die-bonding film further
having a saturation moisture absorption of 1.0% by volume or less.
7. A process according to claim 6, wherein said step of bonding comprises bonding with an organic die-bonding film further
having a void volume of 10% or less in terms of voids present in the material of the film, and at an interface between said film
and said support at a stage where the semiconductor has been bonded to said support by said film.
8. A process according to claim 7, further comprising the step of:
encapsulating the bonded chip to produce the semiconductor device.
9. A process according to claim 1, wherein said die-bonding material is a film comprising one or more resins selected from
the group consisting of silicone resin, acrylic resin, polyimide resin and epoxy resin.
10. A process according to claim 7, wherein said die-bonding material is a film comprising one or more resins selected from
the group consisting of silicone resin, acrylic resin, polyimide resin and epoxy resin.

[continued on page 2]

MAILING ADDRESS OF SENDER:
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2300 Ninth Street, South, Suite PH-1
Arlington, VA 22204

PATENT NO. 6,717,242

No. of additional copies

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(and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1.0 hour to
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UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

Page 2 of 3

PATENT NO. : 6,717,242 *B2*

DATED : April 6, 2004

INVENTOR(S) : Takeda, Shinji; Masuko, Takashi; Yusa, Masami; Kikuchi, Tooru; Miyadera, Yasuo; Maekawa, Iwao;
Yamasaki, Mitsuo; Kageyama, Akira; and Kaneda, Aizou

It is certified that error appears in the above-identified patent and that said Letters Patent
is hereby corrected as shown below:

[continued from page 1]

11. A process according to claim 8, wherein said die-bonding material is a film comprising one or more resins selected from the group consisting of silicone resin, acrylic resin, polyimide resin and epoxy resin.
12. A process according to claim 1, wherein said die-bonding material is a film comprising a polyimide resin and epoxy resin.
13. A process according to claim 7, wherein said die-bonding material is a film comprising a polyimide resin and epoxy resin.
14. A process according to claim 8, wherein said die-bonding material is a film comprising a polyimide resin and epoxy resin.
15. A process according to claim 1, wherein said die-bonding material is a film comprising an acrylic resin and epoxy resin.
16. A process according to claim 7, wherein said die-bonding material is a film comprising an acrylic resin and epoxy resin.
17. A process according to claim 8, wherein said die-bonding material is a film comprising an acrylic resin and epoxy resin.
18. A process according to claim 1, wherein said die-bonding material is a film comprising a silicone resin.
19. A process according to claim 7, wherein said die-bonding material is a film comprising a silicone resin.
20. A process according to claim 8, wherein said die-bonding material is a film comprising a silicone resin.
21. A process according to claim 1, wherein said die-bonding material is a film comprising a silicone resin and epoxy resin.
22. A process according to claim 7, wherein said die-bonding material is a film comprising a silicone resin and epoxy resin.
23. A process according to claim 8, wherein said die-bonding material is a film comprising a silicone resin and epoxy resin.
24. A process according to claim 12, wherein the polyimide is a polyimide synthesized from a combination which is selected from consisting of a combination of 1,2-(ethylene)bis(trimellitate anhydride) and bis(4-amino-3,5-dimethylphenyl)methane; a combination of (ethylene)bis(trimellitate anhydride) and 4,4'-diaminodiphenylether; a combination of 1,2-(ethylene)bis(trimellitate anhydride) and 4,4'-diaminodiphenylether; a combination of 1,2-(ethylene)bis(trimellitate anhydride) and 2,2-bis[4-(4-aminophenoxy)phenyl]propane; a combination of a mixture of 1,2-(ethylene)bis(trimellitate anhydride) and 1,10-(decamethylene)bis(trimellitate anhydride) being the same mol as the mixture and 2,2-bis[4-(4-aminophenoxy)phenyl]propane; combination of 1,10-(decamethylene)bis(trimellitate anhydride) and 2,2-bis[4-(4-aminophenoxy)phenyl]propane.

[continued on page 3]

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PATENT NO. 6,717,242

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UNITED STATES PATENT AND TRADEMARK OFFICE
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Page 3 of 3

PATENT NO. : 6,717,242 *B2*
DATED : April 6, 2004
INVENTOR(S) : Takeda, Shinji; Masuko, Takashi; Yusa, Masami; Kikuchi, Tooru; Miyadera, Yasuo; Maekawa, Iwao;
Yamasaki, Mitsuo; Kageyama, Akira; and Kaneda, Aizou

It is certified that error appears in the above-identified patent and that said Letters Patent
is hereby corrected as shown below:

[continued from page 2]

25. A process according to claim 1, wherein said step of bonding is carried out with a bonding time of from 0.1 seconds (inclusive) to 2 seconds.
26. A process according to claim 7, wherein said step of bonding is carried out with a bonding time of from 0.1 seconds (inclusive) to 2 seconds.
27. A process according to claim 8, wherein said step of bonding is carried out with a bonding time of from 0.1 seconds (inclusive) to 2 seconds.
28. A process according to claim 1, wherein said step of bonding is carried out with a bonding time of from 0.1 seconds (inclusive) to 1.5 seconds.
29. A process according to claim 7, wherein said step of bonding is carried out with a bonding time of from 0.1 seconds (inclusive) to 1.5 seconds.
30. A process according to claim 8, wherein said step of bonding is carried out with a bonding time of from 0.1 seconds (inclusive) to 1.5 seconds.
31. A process according to claim 1, wherein said step of bonding is carried out at a pressure of 0.1-4 gf/mm².
32. A process according to claim 7, wherein said step of bonding is carried out at a pressure of 0.1-4 gf/mm².
33. A process according to claim 8, wherein said step of bonding is carried out at a pressure of 0.1-4 gf/mm².
34. A process according to claim 25, wherein said step of bonding is carried out at a pressure of 0.1-4 gf/mm².
35. A process according to claim 28, wherein said step of bonding is carried out at a pressure of 0.1-4 gf/mm².
36. A process according to claim 1, wherein said step of bonding is carried out at a pressure of 0.3-2 gf/mm².
37. A process according to claim 7, wherein said step of bonding is carried out at a pressure of 0.3-2 gf/mm².
38. A process according to claim 8, wherein said step of bonding is carried out at a pressure of 0.3-2 gf/mm².
39. A process according to claim 25, wherein said step of bonding is carried out at a pressure of 0.3-2 gf/mm².
40. A process according to claim 28, wherein said step of bonding is carried out at a pressure of 0.3-2 gf/mm².
41. A semiconductor device made by the process of claim 1.

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PATENT NO. 6,717,242

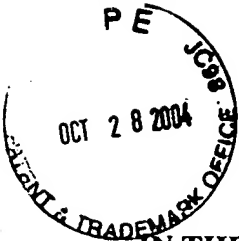
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Continuation Application of:)
Shinji TAKEDA et al.) Atty. Docket: TM&K0006
Serial No. _____ (based on U. S.)
Patent Application Serial No. 08/981,702,)
filed March 31, 1998))
Filed: Herewith)
For: SEMICONDUCTOR DEVICE AND)
PROCESS FOR FABRICATION) Date: February 20, 2001
THEREOF)

PRELIMINARY AMENDMENT (A)

BOX: PATENT APPLICATION
Assistant Commissioner of Patents
Washington, D. C. 20231

Sir:

Prior to calculating the filing fee, please amend the above-captioned application as follows:

IN THE SPECIFICATION:

On page 1, immediately below the title, please insert the following paragraph:

-- This application is a continuation of U. S. Patent Application Serial No. 08/981,702, filed March 31, 1998, which in turn corresponds to International Application No. PCT/JP96/01886, filed July 8, 1996, which in turn is related to and claims the early filing date of Japanese Patent Application No. 7-171154, filed July 6,

1995. The entire disclosures of the above applications are hereby incorporated by reference. --

IN THE CLAIMS:

Please cancel all of the claims, i.e., claims 1-24, without prejudice and substitute therefore the following new claims 25-65:

-- 25. A process for fabricating a semiconductor device, comprising the step of:

bonding a semiconductor device to a support with an organic die-bonding film at conditions of temperature of 100-250°C and pressure of 0.1-30 gf/mm² to produce a bonded chip wherein the organic die-bonding film has a peel strength of 0.5 kgf/(5 mm x 5mm chip) or higher.

26. A process according to claim 25, further comprising the step of:
encapsulating the bonded chip to produce the semiconductor device.

27. A process according to claim 25, wherein said step of bonding comprises bonding with an organic die-bonding film having a modulus of elasticity of 10 Mpa or less at a temperature of 250°C.

28. A process according to claim 27, wherein said step of bonding comprises bonding with an organic die-bonding film further having a water absorption of 1.5% by volume or less.

29. A process according to claim 28, wherein said step of bonding comprises bonding with an organic die-bonding film further having a residual volatile component in an amount of not more than 3.0% by weight.

30. A process according to claim 29, wherein said step of bonding comprises bonding with an organic die-bonding film further having a saturation moisture absorption of 1.0% by volume or less.

31. A process according to claim 30, wherein said step of bonding comprises bonding with an organic die-bonding film further having a void volume of 10% or less in terms of voids present in the material and at an interface between said film and said support at a stage where the semiconductor has been bonded to the support member by the film.

32. A process according to claim 31, further comprising the step of: encapsulating the bonded chip to produce the semiconductor device.

33. A process according to claim 25, wherein said die-bonding material is a film comprising one or more resins selected from the group consisting of silicone resin, acrylic resin, polyimide resin and epoxy resin.

34. A process according to claim 31, wherein said die-bonding material is a film comprising one or more resins selected from the group consisting of silicone resin, acrylic resin, polyimide resin and epoxy resin.

35. A process according to claim 32, wherein said die-bonding material is a film comprising one or more resins selected from the group consisting of silicone resin, acrylic resin, polyimide resin and epoxy resin.

36. A process according to claim 25, wherein said die-bonding material is a film comprising a polyimide resin and epoxy resin.

37. A process according to claim 31, wherein said die-bonding material is a film comprising a polyimide resin and epoxy resin.

38. A process according to claim 32, , wherein said die-bonding material is a film comprising a polyimide resin and epoxy resin.

39. A process according to claim 25, wherein said die-bonding material is a film comprising an acrylic resin and epoxy resin.

40. A process according to claim 31, wherein said die-bonding material is a film comprising an acrylic resin and epoxy resin.

41. A process according to claim 32, wherein said die-bonding material is a film comprising an acrylic resin and epoxy resin.

42. A process according to claim 25, wherein said die-bonding material is a film comprising a silicone resin.

43. A process according to claim 31, wherein said die-bonding material is a film comprising a silicone resin.

44. A process according to claim 32, wherein said die-bonding material is a film comprising a silicone resin.

45. A process according to claim 25, wherein said die-bonding material is a film comprising a silicone resin and epoxy resin.

46. A process according to claim 31, wherein said die-bonding material is a film comprising a silicone resin and epoxy resin.

47. A process according to claim 32, wherein said die-bonding material is a film comprising a silicone resin and epoxy resin.

48. A process according to claim 36, wherein the polyimide is a polyimide synthesized from a combination which is selected from the group consisting of a

combination of 1,2-(ethylene)bis(trimellitate anhydride) and bis(4-amino-3,5-dimethylphenyl)methane; a combination of 1,2-(ethylene)bis(trimellitate anhydride) and 4,4'-diaminodiphenylether; a combination of 1,2-(ethylene)bis(trimellitate anhydride) and bis(4-amino-3,5-diisopropylphenyl)methane; a combination of 1,2-(ethylene)bis(trimellitate anhydride) and 2,2-bis[4-(4-aminophenoxy)phenyl] propane; a combination of a mixture of 1,2-(ethylene)bis(trimellitate anhydride) and 1,10-(decamethylene)bis(trimellitate anhydride) being the same mol as the mixture and 2,2-bis[4-(4-aminophenoxy)phenyl] propane; and a combination of 1,10-(decamethylene)bis(trimellitate anhydride) and 2,2-bis[4-(4-aminophenoxy)phenyl] propane.

49. A process according to claim 25, wherein said step of bonding is carried out with a bonding time of from 0.1 seconds (inclusive) to 2 seconds.

50. A process according to claim 31, wherein said step of bonding is carried out with a bonding time of from 0.1 seconds (inclusive) to 2 seconds.

51. A process according to claim 32, wherein said step of bonding is carried out with a bonding time of from 0.1 seconds (inclusive) to 2 seconds.

52. A process according to claim 25, wherein said step of bonding is carried out with a bonding time of from 0.1 seconds (inclusive) to 1.5 seconds.

53. A process according to claim 31, wherein said step of bonding is carried out with a bonding time of from 0.1 seconds (inclusive) to 1.5 seconds.

54. A process according to claim 32, wherein said step of bonding is carried out with a bonding time of from 0.1 seconds (inclusive) to 1.5 seconds.

55. A process according to claim 25, wherein said step of bonding is carried out at a pressure of 0.1-4 gf/mm².

56. A process according to claim 31, wherein said step of bonding is carried out at a pressure of 0.1-4 gf/mm².

57. A process according to claim 32, wherein said step of bonding is carried out at a pressure of 0.1-4 gf/mm².

58. A process according to claim 49, wherein said step of bonding is carried out at a pressure of 0.1-4 gf/mm².

59. A process according to claim 52, wherein said step of bonding is carried out at a pressure of 0.1-4 gf/mm².

60. A process according to claim 25, wherein said step of bonding is carried out at a pressure of 0.3-2 gf/mm².

61. A process according to claim 31, wherein said step of bonding is carried out at a pressure of 0.3-2 gf/mm².

62. A process according to claim 32, wherein said step of bonding is carried out at a pressure of 0.3-2 gf/mm².

63. A process according to claim 49, wherein said step of bonding is carried out at a pressure of 0.3-2 gf/mm².

64. A process according to claim 52, wherein said step of bonding is carried out at a pressure of 0.3-2 gf/mm².

65. A semiconductor device made by the process of claim 25. --

REMARKS

With the above amendments, the specification has been amended to identify and incorporate by reference the parent application, i.e., Serial No. 08/981,702, as well as the international application and Japanese application upon which the present application claims priority.

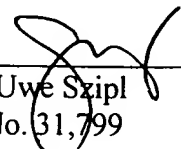
Additionally, all of the claims originally filed with the parent application, i.e., claims 1-24, have been cancelled and new claims 25-65 have been inserted for prosecution in this continuation application.

Accordingly, it is believed that this application is in good condition for examination, and the Examiner's early and favorable action is respectfully solicited.

Questions are welcomed by the below-signed attorney for applicants.

Respectfully submitted,

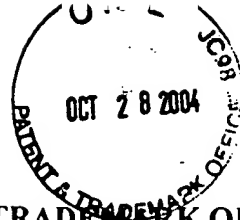
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:)
Shinji TAKEDA et al.) Atty. Docket No.: TM&K0006
Serial No. 09/785,194) Group Art Unit: 2814
Filed: February 20, 2001) Examiner: GRAYBILL, D.
For: SEMICONDUCTOR DEVICE AND) Date: June 25, 2002
PROCESS FOR FABRICATION)
THEREOF)

AMENDMENT (B)

Box: Fee Amendment
Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

In response to the official Office Action dated December 26, 2001, please amend the above captioned application as follows.

IN THE CLAIMS

Kindly amend claim 48 as follows:

48. (Amended) A process according to claim 36, wherein the polyimide is a polyimide synthesized from a combination which is selected from the group consisting of a combination of 1,2-(ethylene)bis(trimellitate anhydride) and bis(4-amino-3,5-dimethylphenyl)methane; a combination of 1,2-(ethylene)bis(trimellitate anhydride) and 4,4'-diaminodiphenylether; a combination of 1,2-(ethylene)bis(trimellitate anhydride) and bis(4-amino-3,5-diisopropylphenyl)methane; a combination of 1,2-(ethylene)bis(trimellitate anhydride) and 2,2-bis[4-(4-aminophenoxy)phenyl]propane; a combination of a mixture of 1,2-

(ethylene)bis(trimellitate anhydride) and 1,10-(decamethylene)bis(trimellitate anhydride) being the same mol as the mixture and 2,2-bis[4-(4-aminophenoxy)phenyl]propane; and a combination of 1,10-(decamethylene)bis(trimellitate anhydride) and 2,2-bis[4-(4-aminophenoxy)phenyl]propane.

REMARKS

Claim 48 has been amended to correct a minor typographical error. No new matter has been added.

Applicants respectfully request that the present application be reconsidered and the claims allowed for the following reasons.

The Invention

The present invention pertains broadly to a process for fabricating a semiconductor device that has a support member, such as a lead frame, to which a semiconductor die or chip is attached using a die-bonding material. More particularly, the first preferred embodiment in accordance with the invention is a process for fabricating a semiconductor device characterized by the step of bonding a semiconductor device to a support with an organic die-bonding film at conditions of temperature 100-250°C and pressure of 0.1-30 gf/mm² to produce a bonded chip wherein the organic die-bonding film has a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher. All of the remaining dependent claims represent other preferred embodiments that are modifications of the first preferred embodiment.

The advantage of the claimed invention and the various modifications is that a process is provided for the manufacture of semiconductor devices that have fewer flow cracks and other defects that devices made with silver paste have because the fabrication process of the present invention produces semiconductor devices that are less prone to formation of reflow cracks during the fabrication process. Thus, the semiconductor devices made by the process of the

claimed invention are more reliably manufactured and have better durability than semiconductor devices manufactured by the prior art fabrication processes.

The Rejections

Claims 25-30, 33, 36, 48, 49, 52, 55, 58-60 and 63-65 stand rejected under 35 U.S.C. 103(a) as unpatentable over Morita et al. (U.S. Patent 5,406,124). Claims 31, 32, 34, 35, 37, 38, 50, 51, 53, 54, 56, 57, 61, and 62 stand rejected under 35 U.S.C. 103(a) as unpatentable over Morita in view of Hozoji (Japanese document JP5-218107). Claims 39, 42, and 45 stand rejected under 35 U.S.C. 103(a) as unpatentable over Morita in view of Sakumoto (U.S. Patent 5,277,972). Claims 40, 41, 43, 44, 46 and 47 stand rejected under 35 U.S.C. 103(a) as unpatentable over the combination of Morita and Hozoji, and further in view of Sakumoto.

Applicants traverse the Examiner's rejection for the following reasons.

Applicant's Arguments

The Morita reference discloses an "insulating adhesive tape" that includes a base supporting film and an adhesive layer formed on at least one surface thereof (see Abstract). The adhesive layer is a thermoplastic polymer comprising a thermoplastic polyimide, wherein the polymer has a glass transition temperature ranging from 180°C to 280°C and an elastic modulus ranging from 10^{10} dyne/cm² to 10^{11} dyne/cm² at 25°C, wherein the elastic modulus includes a value ranging from 10^2 dyne/cm² to 10^9 dyne/cm² at a temperature between 250°C and 300°C. The Morita reference discloses that the thermoplastic polymer has a water absorbing ratio of less than 1.2% (col. 9, lines 14-16); however, Morita does not explicitly state to what the percentage is relative. Specifically, the Morita reference only describes % by weight (col. 9, lines 35-39

and lines 53-55); therefore, it is suggested that Morita describes that the water absorbing ratio is less than 1.2% by weight. There is nothing in the Morita et al. reference to teach, or even suggest, that the water absorbtion is 1.5% by volume or less as required by claim 28.

The Morita reference also discloses that the adhesive temperature for bonding IC chips to lead frames using the adhesive tape is selected from the range of 250-450°C (preferably 270-400°C) and the adhesive pressure is 1-50 kg/cm² (preferably 5-30 kg/cm²), (col. 14, lines 3-14). However, the presently claimed invention recites bonding conditions to include the combination of a bonding temperature of 100-250°C and a bonding pressure of 0.1-30 gf/mm² as recited in independent claim 25.

Furthermore, Applicants point out that the Examiner admits that the Morita reference does not disclose a “17 degree peel strength of 0.5 Kgf/5mm x 5mm chip or above” (Office Action, dated December 26, 2001, page 6, lines 1 to page 7, line 2), but the Examiner asserts that in the absence of unexpected results that such an increase in peel strength would be “ascertainable by routine experimentation and optimization” (Office Action, dated December 26, 2001, page 6, lines 13-17); however, the Examiner does concede that “a disclosure that the limitations...produce an unexpected result, or are otherwise critical” would rebut any established *prima facie* case of obviousness (Office Action, dated December 26, 2001, page 6, line 20 to page 7, line 2)..

Applicants produce such a disclosure and make such a rebuttal. Applicants submit for the Examiner a Declaration by Takashi Masuko (hereafter the “Masuko Declaration”), dated March 5, 2002, attached herewith and filed in accordance with 37 C.F.R. 1.132. The Masuko Declaration establishes that when the novel film (see Section 7 on page 3) in accordance with the present invention is compared to the prior art film (see Section 6 on page 3) disclosed by Morita

et al. under identical experimental conditions, the result is that the novel film of the present invention demonstrates an "unexpected invulnerability" (page 7, lines 4-8). As shown in Table 2, when evaluating the two films for the occurrence of reflow cracks it was shown that while all of the Morita film samples under the given die-bonding conditions manifested reflow cracks, none of the samples made in accordance with the present invention had reflow cracks. In addition, when peel strength was measured (Matsuko Declaration, section 8) the peel strength was significantly greater for the novel film of the present invention over the Morita film (see Table 1). In fact, when the die-bonding condition was set as "250°C x 30gf/mm² x 20 sec," all of the chips made using the novel film were destroyed during testing because the bond strength was stronger than the chip. In other words, the bond strength of the material in accordance with the present invention was stronger than what this particular test could measure! Clearly, this is another superior and unexpected result.

In view of the Masuko Declaration, the *prima facie* case of obviousness standing against independent claim 25 has been sufficiently rebutted to be overcome by the results because of the superior and unexpected result of the material having "a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher" as recited in claim 25.

Thus, the Morita et al. reference can not anticipate, or render obvious, the subject matter of base claim 25 because Morita et al. does not teach, or even suggest, (a) the "organic die-bonding film has a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher," and (b) the combination of conditions of "temperature 100-250°C and pressure of 0.1-30 gf/mm²." Morita et al. also do not teach, or even suggest, bonding with an organic die-bonding film having a "water absorption of 1.5% by volume or less" as recited in claim 28. However, even if a *prima facie* case of obviousness can be inferred from the teachings of Morita (which it can not) it is

plainly shown that the present invention provides superior and unexpected improvements in both peel strength and reflow crack development over the Morita et al. adhesive tape. Specifically, the peel strength of the novel film in accordance with the present invention is consistently and significantly stronger than the peel strength of the Morita et al. film, and in some cases the peel strength of the instant novel film was so strong that it could not be fully measured using the present techniques. In addition, the novel film in accordance with the present invention was "unexpectedly invulnerable" to the formation of reflow cracks, whereas 100% of the Morita films developed reflow cracks.

Hozoji discloses a "resin-sealed semiconductor device" wherein a die pad and a semiconductor element are fixed by using an adhesive layer in which a base material having a low moisture absorption rate (i.e. glass cloth or metal foil) is impregnated or coated with a bisphenol type epoxy resin, wire bonded, and with resin containing one or more of epoxy, phenol or polyimide resins (see Abstract). In addition, Hozoji teaches several desired low water absorption rates being changes in weight over a period of time (see paragraph [0016] and Table 1). Hozoji does not teach a "water absorption of 1.5% by volume or less" as recited in claims 28. The Hozoji reference is silent with respect to the property of peel strength.

The Sakumoto et al. reference discloses an "adhesive tape" for electronic parts wherein the adhesive tape includes a heat resistant base film, and an adhesive layer laminated on at least one side of the base film, the adhesive layer comprising a resol type phenol resin and an acrylonitrile/butadiene copolymer (see Abstract). As admitted by the Examiner (Office Action, dated December 26, 2001, page 11, lines 13-16), Sakumoto et al. do not teach the particular combinations of compounds recited in claim 48. The Examiner argues that it would be a matter of routine experimentation to make such combinations. Applicant disagrees. The Sakumoto et

al. reference discloses the use of epoxy resins, acrylic resins, silicone resins and other resins (col. 9, lines 26-30). Applicants assert that the Sakumoto et al. reference generally discloses classes of compounds that are so broad as to justify that it would be a matter of "routine observation and experimentation" to come to the subject matter of claim 48. The list of compound classes disclosed by Sakumoto et al. does not mention "1,2(ethylene)bis(trimellitate anhydride)" as is recited in claim 48.

Sakumoto et al. is silent with respect to the property of peel strength.

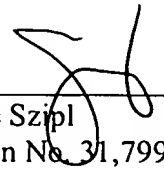
Conclusion

Neither the Morita et. al. reference, nor the Hozoji et al. reference, nor the Sakumoto et al. reference teach that "the organic die-bonding film has a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher" as recited in claim 17. Therefore, the *prima facie* case of obviousness is untenable and should be withdrawn. Furthermore, even if a *prima facie* case of obviousness could be reasonably established (which it can not), the experimental evidence provided by the Masuko Declaration clearly demonstrates unobvious and unexpected results pertaining to the invention of claim 17, thereby sufficiently rebutting and overcoming the rejection.

For all of the above reasons, claims 25-65 are in condition for allowance, and prompt notice of allowance is earnestly solicited. Questions are welcomed by the below-signed attorney for applicants.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

48. (Amended) A process according to claim 36, wherein the polyimide is a polyimide synthesized from a combination which is selected from the group consisting of a combination of 1,2-(ethylene)bis(trimellitate anhydride) and bis(4-amino-3,5-dimethylphenyl)methane; a combination of 1,2-(ethylene)bis(trimellitate anhydride) and 4,4'-diaminodiphenylether; a combination of 1,2-(ethylene)bis(trimellitate anhydride) and bis(4-amino-3,5-diisopropylphenyl)methane; a combination of 1,2-(ethylene)bis(trimellitate anhydride) and 2,2-bis[4-(4-aminophenoxy)phenyl]propane; a combination of a mixture of 1,2-(ethylene)bis(trimellitate anhydride) and 1,10-(decamethylene)bis(trimellitate anhydride) being the same mol as the mixture and 2,2-bis[4-(4-aminophenoxy)phenyl]propane; and a combination of 1,10-(decamethylene)bis(trimellitate anhydride) and 2,2-bis[4-(4-aminophenoxy)phenyl]propane.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:)
Shinji TAKEDA et al.) Atty. Docket No.: TM&K0006
Serial No. 09/785,194) Group Art Unit: 2827
Filed: February 20, 2001) Examiner: GRAYBILL, D.
For: SEMICONDUCTOR DEVICE AND) Date: April 24, 2003
PROCESS FOR FABRICATION)
THEREOF)

AMENDMENT (C)

Box: Fee Amendment
Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

In response to the official Office Action dated December 24, 2002, please amend the
above captioned application as follows.

IN THE CLAIMS

Kindly amend claim 31 as follows:

31. (Amended) A process according to claim 30, wherein said step of bonding
comprises bonding with an organic die-bonding film further having a void volume of 10% or less
in terms of voids present in the material of the film, and at an interface between said film and
said support at a stage where the semiconductor has been bonded to said support by said film.

REMARKS

Claim 31 has been amended to particularly point out and distinctly claim the embodiment in accordance with the present invention that is described by this claim. No new matter has been added.

Applicants respectfully request that the present application be reconsidered and the claims allowed for the following reasons.

The Invention

The present invention pertains broadly to a process for fabricating a semiconductor device that has a support member, such as a lead frame, to which a semiconductor die or chip is attached using a die-bonding material. More particularly, the first preferred embodiment in accordance with the invention is a process for fabricating a semiconductor device characterized by the step of bonding a semiconductor device to a support with an organic die-bonding film at conditions of temperature 100-250°C and pressure of 0.1-30 gf/mm², wherein the organic die-bonding film has a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher, to produce a bonded chip. All of the remaining dependent claims represent other preferred embodiments that are modifications of the first preferred embodiment.

The advantage of the claimed invention and the various modifications is that a process is provided for the manufacture of semiconductor devices that have fewer flow cracks and other defects that devices made with silver paste have because the fabrication process of the present invention produces semiconductor devices that are less prone to formation of reflow cracks during the fabrication process. Thus, the semiconductor devices made by the process of the

claimed invention are more reliably manufactured and have better durability than semiconductor devices manufactured by the prior art fabrication processes.

The Rejections

Claim 31 stands rejected under 35 U.S.C. 112, second paragraph, as indefinite. Claims 25-30, 33, 36, 48, 49, 52, 55, 58-60 and 63-65 stand rejected under 35 U.S.C. 102(a) as anticipated by, or in the alternative under 35 U.S.C. 103(a) as unpatentable over, Morita et al. (U.S. Patent 5,406,124). Claims 31, 32, 34, 35, 37, 38, 50, 51, 53, 54, 56, 57, 61, and 62 stand rejected under 35 U.S.C. 103(a) as unpatentable over Morita in view of Hozoji (Japanese document JP5-218107). Claims 39, 42, and 45 stand rejected under 35 U.S.C. 103(a) as unpatentable over Morita in view of Sakumoto (U.S. Patent 5,277,972). Claims 40, 41, 43, 44, 46 and 47 stand rejected under 35 U.S.C. 103(a) as unpatentable over the combination of Morita and Hozoji, and further in view of Sakumoto.

Applicants traverse the Examiner's rejection for the following reasons.

Applicant's Arguments

As an initial matter, Applicants assert that claims 25-65 are in compliance with 35 U.S.C. 112.

The Morita reference discloses an "insulating adhesive tape" that includes a base supporting film and an adhesive layer formed on at least one surface thereof (see Abstract). The adhesive layer is a thermoplastic polymer comprising a thermoplastic polyimide, wherein the polymer has a glass transition temperature ranging from 180°C to 280°C and an elastic modulus

ranging from 10^{10} dyne/cm² to 10^{11} dyne/cm² at 25°C, wherein the elastic modulus includes a value ranging from 10^2 dyne/cm² to 10^9 dyne/cm² at a temperature between 250°C and 300°C.

The Morita reference also discloses that the adhesive temperature for bonding IC chips to lead frames using the adhesive tape is selected from the range of 250-450°C (preferably 270-400°C) and the adhesive pressure is 1-50 kg/cm² (preferably 5-30 kg/cm²), (col. 14, lines 3-14). However, the presently claimed invention recites bonding conditions to include the combination of a bonding temperature of 100-250°C and a bonding pressure of 0.1-30 gf/mm² as recited in independent claim 25.

Furthermore, Applicants point out that the Examiner notes that the Morita reference does not disclose a die-bonding film having a "17 degree peel strength of 0.5 Kgf/5mm x 5mm chip or above" (Office Action, dated December 26, 2001, page 6, lines 1 to page 7, line 2), but the Examiner asserts that in the absence of unexpected results that such an increase in peel strength would be "ascertainable by routine experimentation and optimization" (Office Action, dated December 26, 2001, page 6, lines 13-17). However, the Examiner does concede that "a disclosure that the limitations...produce an unexpected result, or are otherwise critical" would rebut any established prima facie case of obviousness (Office Action, dated December 26, 2001, page 6, line 20 to page 7, line 2).

Rebuttal of Examiner's Anticipation Rejection

The Examiner asserts that the Morita et al. reference anticipates, under 35 U.S.C. 102(a), the subject matter of independent claim 25 of the present invention. However, the courts have held that to establish lack of novelty under 35 U.S.C. 102 the asserted anticipating reference must identically describe every element in the claims, and the burden is for the Examiner, not the Applicant, to show that every element of the claims is identically described in the asserted

anticipating reference. Continental Can. Co. USA Inc. v Monsanto Co., 20 USPQ2d 1746, 1748 (Fed. Cir. 1991). Furthermore, where the asserted anticipating reference fails to explicitly teach a certain characteristic, the disclosure must be sufficient to show that the characteristic at issue flows as a natural result from the teachings of the reference. *Id.* at 1749.

In the present case, the Examiner has made no effort to show that Morita et al. discloses a process recited in claim 25 that includes bonding with "an organic die-bonding film...wherein the organic die-bonding film has a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher." In other words, for the Morita et al. reference to anticipate the subject matter of claim 25, Morita et al. must teach a die-bonding film used for bonding as in the recited process wherein the die-bonding film has the property of a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher. As stated by the Examiner himself, "[i]n particular, Morita does not appear to explicitly teach that the process results in a peel strength of 0.5 kgf/(5 mm x 5mm chip) or higher" (Office Action dated December 24, 2002, page 10, lines 4-6). Applicants agree.

To assert that the Morita et al. reference anticipates the subject matter of instant claim 25, it is the Examiner's burden to explicitly point out where in the Morita et al. reference there is sufficient disclosure to show that bonding with a die-bonding material having a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher is the natural result flowing from the teachings of the Morita et al. reference. This the Examiner cannot do for two reasons. First, the Examiner has rightly pointed out that the required peel strength is not necessarily present in the die-bonding film disclosed by the Morita et al. reference (Office Action dated December 24, 2002, page 10, lines 6-11). Second, the Rule 132 Declaration by Masuko, (hereafter, the "Masuko Declaration"), filed June 25, 2002, provides clear factual evidence in Table I to show that a die-bonding film made in accordance with the teachings of the Morita et al. reference does not have

a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher. In other words, the factual evidence provided in Table 1 of the Masuko Declaration destroys any inherency argument.

Rebuttal of Examiner's Obviousness Rejection

The Examiner asserts that the Morita et al. reference renders obvious, under 35 U.S.C. 103(a), the subject matter of independent claim 25 of the present invention. Applicants disagree.

The thrust of the Examiner's argument appears to be that Morita et al. teaches it would be "desirable" to manufacture a stronger die-bonding film, from which the Examiner concludes that such a desire renders obvious the manufacture of a die-bonding film, having the recited peel strength, as used for bonding in claim 25 (Office Action dated December 24, 2002, page 10, lines 16-20). The Examiner argues that it would be a matter of routine optimization and well known manufacturing constraints to manufacture the particular die-bonding film having the required peel strength property as used in the process of instant claim 25 (Office Action dated December 24, 2002, page 10, lines 16-20).

Applicants disagree with the Examiner's conclusion because it is precatory. The Examiner's argument expresses the desirability of a making a die-bonding film having the claimed peel strength property but does not provide any factual support from the Morita et al. reference, or from another source, as to how such a die-bonding film could be manufactured. The Examiner attempts to fill in the gaps by arguing that "well known manufacturing constraints" could be applied to the teachings of the Morita et al. reference, and that by the use of these "manufacturing constraints" the die-bonding film having the required properties would emerge "by optimization and routine experimentation" (Office Action, dated December 24, 2002, page 10, lines 16-20). Such statements appear conclusory as based on a desire to achieve a certain result and appear to lack evidentiary support from the prior art. Thus, Applicants assert that the

Examiner has not properly established a rejection under 35 U.S.C. 103(a) because the record does not reflect a factual basis establishing bonding with a die-bonding film having a "peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher" as recited in the process of claim 25.

Even if one were to assume that the Morita et al. reference does suggest a die-bonding film having the required peel strength property, which is not a valid assumption, Applicants have provided factual evidence of unobvious, unexpected results in the Masuko Declaration that overcomes any prima facie case of obviousness.

Unexpected and Superior Results

The Masuko Declaration establishes that when the novel film (see Section 7 on page 3) in accordance with the present invention is compared to the prior art film (see Section 6 on page 3) disclosed by Morita et al. under identical experimental conditions, the result is that the novel film of the present invention demonstrates an "unexpected invulnerability" (page 7, lines 4-8). As shown in Table 2, when evaluating the two films for the occurrence of reflow cracks it was shown that while all of the Morita film samples under the given die-bonding conditions manifested reflow cracks, none of the samples made in accordance with the present invention had reflow cracks.

In addition, when peel strength was measured (Masuko Declaration, section 8) the peel strength was significantly greater for the novel film of the present invention over the Morita film (see Table 1). In fact, when the die-bonding condition was set as "250°C x 30gf/mm² x 20 sec," all of the chips made using the novel film were destroyed during testing because the bond strength was stronger than the chip. In other words, the bond strength of the film material in accordance with the present invention was stronger than what this particular test could measure! Clearly, this is another superior and unexpected result.

Examiner has not properly established a rejection under 35 U.S.C. 103(a) because the record does not reflect a factual basis establishing bonding with a die-bonding film having a “peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher” as recited in the process of claim 25.

Even if one were to assume that the Morita et al. reference does suggest a die-bonding film having the required peel strength property, which is not a valid assumption, Applicants have provided factual evidence of unobvious, unexpected results in the Masuko Declaration that overcomes any prima facie case of obviousness.

Unexpected and Superior Results

The Masuko Declaration establishes that when the novel film (see Section 7 on page 3) in accordance with the present invention is compared to the prior art film (see Section 6 on page 3) disclosed by Morita et al. under identical experimental conditions, the result is that the novel film of the present invention demonstrates an “unexpected invulnerability” (page 7, lines 4-8). As shown in Table 2, when evaluating the two films for the occurrence of reflow cracks it was shown that while all of the Morita film samples under the given die-bonding conditions manifested reflow cracks, none of the samples made in accordance with the present invention had reflow cracks.

In addition, when peel strength was measured (Masuko Declaration, section 8) the peel strength was significantly greater for the novel film of the present invention over the Morita film (see Table-1). In fact, when the die-bonding condition was set as “250°C x 30gf/mm² x 20 sec,” all of the chips made using the novel film were destroyed during testing because the bond strength was stronger than the chip. In other words, the bond strength of the film material in accordance with the present invention was stronger than what this particular test could measure! Clearly, this is another superior and unexpected result.

In view of the Masuko Declaration, the prima facie case of obviousness standing against independent claim 25 has been sufficiently rebutted to be overcome by the factual results, which includes the superior and unexpected result of the die-bonding film having "a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher" as recited in claim 25.

Sufficiency of the Masuko Declaration

The Examiner asserts that the Masuko Declaration is "insufficient" for the following reasons: (a) "it refers only to the system described in the application and not the individual claims of the application," (b) "the objective evidence of nonobviousness is not commensurate in scope with the claims," (c) "it does not compare the claimed invention with the closest prior art," (d) there is no conversion factor between the 90 degree peel strength property taught by Morita et al. and the 17 degree peel strength property used in the Masuko Declaration so no 17 degree peel strength comparison can be made between a die-bonding film disclosed by Morita and a die-bonding film provided by the present invention, and (e) the Morita et al. reference teaches unexpected results at col. 7, lines 65-68, that renders the results provided by the present invention as "not unexpected" (Office Action, dated December 24, 2002, page 16, line 1, to page 17, line 11).

The Examiner argues that the Masuko Declaration is insufficient because it does not refer to individual claims in the application and cites MPEP 716 as supporting authority (Office Action, dated December 24, 2002, page 16, lines 1-5). Applicants traverse the Examiner's position on the basis that MPEP 716 does not require the declaration itself to refer to individual claims. The burden is now placed on the Examiner to show where in the MPEP there is a requirement that the declaration itself refer to any individual claims. The courts require only that "the objective evidence of nonobviousness ...be commensurate in scope with the claims." In re

Clemens, 206 USPQ 289, 296 (CCPA 1980). In the present case the evidence is clearly commensurate in scope with the claims.

The Examiner argues that the Masuko Declaration is insufficient because the objective evidence of nonobviousness is not commensurate in scope with the claims (Office Action, dated December 24, 2002, page 16, lines 6-11). In particular, the Examiner argues that the showing of unexpected results have not been determined to occur over the entire claimed range and cites In re Clemens at 296 in support of this position. Applicants point out that the Examiner has misapplied In re Clemens in the present case.

In Clemens, the condensate polishing process set forth in claims 1-7 and 9-10 differed from the prior art only by the utilization of VBC-based resins, whereas the prior art used CME-based resins. Both parties maintained that the two kinds of resins had very similar structure and that one skilled in the art would have substituted one for the other as prima facie obvious. The unexpected results of comparative testing of the two kinds of resins demonstrated that in the temperature range of 110°C to 130°C the VBC-based resins were significantly more thermally stable than the CME-based resins; however, as recited in the base claim 1 the phrase “elevated temperature” that was interpreted to include temperatures of 60°C, where CME-based resins were thermally stable. Therefore, the court concluded that the probative value of the narrow range of data could not be reasonably extended to prove unobviousness of the broader range of “elevated temperature” that included 60°C. On the other hand, the court held that the comparative data did prove that claim 8, which recited “at a temperature in excess of 100°C,” was unobvious over the prior art. In re Clemens, 206 USPQ 289 (CCPA 1980).

In the present case, one of ordinary skill in the art would readily appreciate that the objective evidence provided in Table I of the Masuko Declaration is commensurate in scope

with claim 25. Specifically, the three sets of temperature and pressure die-bonding conditions tabulated in Table 1 of the Masuko Declaration all fall within the temperature and pressure condition ranges recited in claim 25. In addition, only the 17 degree peel strengths of the organic die-bonding film bonded in accordance with the process of claim 25 achieved the required peel strength of 0.5 kgf/(5 mm x 5mm chip) or higher. On the other hand, the organic die-bonding film made in accordance with the teachings of the Morita et al. reference failed to achieve a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher. The facts of the present case are similar to claim 8 in Clemens, which is the claim the court concluded was allowable because it recited temperature conditions that were within the experimental temperature conditions provided in the Rule 132 Declaration. In view of the facts, and in view of the analysis of Clemens, it is clear that the objective evidence presented in Table 1 of the Masuko Declaration is commensurate in scope with claim 25.

The Examiner argues that Applicants have not compared the present invention to the closest prior art (Office Action, dated December 24, 2002, page 16, lines 12-21). Specifically, the Examiner argues that the closest prior art would be identical to the present invention because Morita et al. lists an "identical polyimide" to the present invention (Office Action, dated December 24, 2002, page 16, lines 14-17). The courts have held that when comparative data is presented, there is no requirement that the Applicant compare "the results of the invention to the results of the invention." In re Chapman, 148 USPQ 711, 714 (CCPA 1966). In other words, whether or not the Morita et al. reference lists polyimides (col. 11, line 13 to col. 13, line 55) that are identical to one or more of the polyimides listed in the present specification (page 16, line 16 to page 17, line 6, and page 10, line 1 to page 14, line 24) is immaterial. The courts have held that when one of ordinary skill in the art must pick and choose from the various subject matter

contained in a single disclosure, the reference cannot be properly used to support a lack of novelty rejection, but may support an obviousness rejection. In re Arkley, 172 USPQ 524, 526 (CCPA 1972). To overcome any prima facie obviousness rejection, Applicants are required to compare the invention to the closest prior art, but not to the invention itself. In re Chapman, 148 USPQ 711, 714 (CCPA 1966). As stated in the Rule 132 Declaration, Applicants believe they have compared the invention to the closest prior art, being Example 1 of the Morita et al. reference (Masuko Declaration, page 3). It makes no sense for applicants to be required to pick and choose from long lists of components to “invent” something to compare their invention to. Applicants have compared the invention to the closest embodiment actually disclosed, which is shown in the examples that is all that Chapman and the other relevant case law requires them to do.

The Examiner argues that “the claimed result cannot be declared unexpected in relation to peel strength of Morita when the relationship between the peel strength of Morita cannot not be determined” (Office Action, dated December 24, 2002, page 17, lines 5-9). Applicants do not require a continuation factor because they have made an actual experimental comparison and found Morita inferior! The fact there is no conversion factor between the 90 degree peel strength disclosed by Morita and the 17 degree peel strength disclosed by Applicant is immaterial to the results provided in the Masuko Declaration. Specifically, the Masuko Declaration provides a direct comparison between the 17 degree peel strengths of the die-bonding film made in accordance with the present invention to the closest prior art die-bonding film disclosed by Morita. Because the Masuko provides a direct factual comparison there is no need to rely upon inferences drawn from the Morita reference. In fact, the data provided by the Masuko reference shows that any inferences drawn about peel strengths from the Morita reference in support of an

obviousness rejection are erroneous. The die-bonding material disclosed by the Morita reference is plainly weaker than the die-bonding material used for bonding in accordance with the conditions recited in claim 25 of the present invention.

Lastly, the Examiner asserts that the Morita reference teaches unexpected results of the magnitude shown in the Masuko Declaration (Office Action, dated December 24, 2002, page 17, lines 9-11). Applicants respectfully disagree. The Examiner relies upon the following statement in Morita as a teaching of unexpected results:

“However, the treatment effect in the thermoplastic polymer layer of the present invention is remarkable beyond expectations. The adhesive strength to the substrate can be improved and stabilized greatly.” (col. 7, lines 65-68).

The Examiner’s reliance is upon mere puffery while the reference may claim its material has great strength, the actual evidence shows that the present invention is superior. This section contains no factual information that could be used to negate the superior and unexpected adhesive properties provided by bonding with the die-bonding film in accordance with the present invention. There is nothing in the Morita et al. reference to teach, or even suggest, that the bond is so strong that the chips shatter before the adhesive gives way. The present invention truly achieves adhesion that “is remarkable beyond expectations.”

For all of the reasons argued above, Applicants assert that the Masuko Declaration is sufficient to overcome any prima facie obviousness rejection in view of the Morita et al. reference.

Applicants incorporate herein the arguments made previously in Amendment (B) filed June 25, 2002, and in Supplemental Response to Amendment (B) filed October 11, 2002.

Applicants specifically reiterate the following.

Hozoji discloses a “resin-sealed semiconductor device” wherein a die pad and a semiconductor element are fixed by using an adhesive layer in which a base material having a low moisture absorption rate (i.e. glass cloth or metal foil) is impregnated or coated with a bisphenol type epoxy resin, wire bonded, and with resin containing one or more of epoxy, phenol or polyimide resins (see Abstract). The Hozoji reference is silent with respect to the property of peel strength.

The Sakumoto et al. reference discloses an “adhesive tape” for electronic parts wherein the adhesive tape includes a heat resistant base film, and an adhesive layer laminated on at least one side of the base film, the adhesive layer comprising a resol type phenol resin and an acrylonitrile/butadiene copolymer (see Abstract). Sakumoto et al. is silent with respect to the property of peel strength.

To reiterate, the Morita et al. reference cannot anticipate, or render obvious, the subject matter of base claim 25 because Morita et al. does not teach, or even suggest, (a) the “organic die-bonding film has a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher,” and (b) the combination of conditions of “temperature 100-250°C and pressure of 0.1-30 gf/mm².” However, even if a prima facie case of obviousness can be inferred from the teachings of Morita (which it can not), it is plainly shown that the present invention provides superior and unexpected improvements in both peel strength and reflow crack development over the Morita et al. adhesive tape. Specifically, the peel strength of the novel film in accordance with the present invention is consistently and significantly stronger than the peel strength of the Morita et al.

film, and in some cases the peel strength of the instant novel film was so strong that it could not be fully measured using the present techniques. In addition, the novel film in accordance with the present invention was “unexpectedly invulnerable” to the formation of reflow cracks, whereas 100% of the Morita films developed reflow cracks.


Conclusion

Neither the Morita et. al. reference, nor the Hozoji et al. reference, nor the Sakumoto et al. reference teach that “the organic die-bonding film has a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher” as recited in claim 25. Therefore, the prima facie case of obviousness is untenable and should be withdrawn. Furthermore, even if a prima facie case of obviousness could be reasonably established (which it can not), the experimental evidence provided by the Masuko Declaration clearly demonstrates unobvious and unexpected results pertaining to the invention of claim 25, thereby sufficiently rebutting and overcoming the rejection.

For all of the above reasons, claims 25-65 are in condition for allowance, and prompt notice of allowance is earnestly solicited. Questions are welcomed by the below-signed attorney for applicants.

Respectfully submitted,

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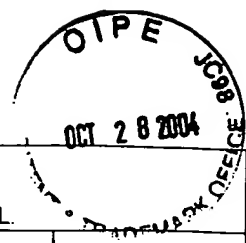
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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

31. (Amended) A process according to claim 30, wherein said step of bonding comprises bonding with an organic die-bonding film further having a void volume of 10% or less in terms of voids present in the material of the film, and at an interface between said film and said support at a stage where the semiconductor has been bonded to said~~the support-member~~ by said~~the~~ film.



Notice of Allowability

Application No.

09/785,194

Examiner

David E Graybill

Applicant(s)

TAKEDA ET AL.

Art Unit

2827

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 4-24-3.
2. ☒ The allowed claim(s) is/are 25-65.
3. ☒ The drawings filed on 20 February 2001 are accepted by the Examiner.
4. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☒ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☒ Certified copies of the priority documents have been received in Application No. 08/981,702.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____

5. ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
 - (a) ☐ The translation of the foreign language provisional application has been received.
6. ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application. **THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

7. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
8. ☐ CORRECTED DRAWINGS must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No. _____
 - (b) ☐ including changes required by the proposed drawing correction filed _____, which has been approved by the Examiner.
 - (c) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No. _____


Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet.

9. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- 1 ☐ Notice of References Cited (PTO-892)
- 3 ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 5 ☐ Information Disclosure Statements (PTO-1449), Paper No. _____
- 7 ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material

- 2 ☐ Notice of Informal Patent Application (PTO-152)
- 4 ☒ Interview Summary (PTO-413), Paper No. _____
- 6 ☐ Examiner's Amendment/Comment
- 8 ☐ Examiner's Statement of Reasons for Allowance
- 9 ☐ Other


David E Graybill
Primary Examiner
Art Unit: 2827